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Exploring Effects of Firm, Industrial, Market and Macroeconomic Volatility on Firm Sales Growth under Heterogeneity in Pakistan

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Abstract

The impact of industrial, firm, macroeconomic and market volatility on growth of 457 non-financial firms listed at Pakistan Stock Exchange (PSX) is examined by using annual unbalanced panel data over the period 1988-2017. Further, we categorize firms into constrained and unconstrained firms based on Whited and Wu (2006) index. In addition, the differential effects of firm, industrial, market and macroeconomic volatilities are also explored for constrained and unconstrained firms. We find that constrained firms are positively affected by macroeconomic and firm level volatility and unconstrained firms are negatively affected by macroeconomic and firm level volatility. On the basis of the empirical findings, it is recommended that the decision makers should take into account the heterogeneity of firms (based on financial constraints) while making decisions. Finally, to achieve higher growth of the firms as well as the economic growth prudent and investor friendly policies should be designed.

Keywords: *Firm sales growth; market volatility; firm volatility; industrial volatility macroeconomic volatility; financial constraints*

JEL Classifications: *D22; D80*

1. Introduction

Firm growth is a key driver of wealth creation, employment generation, and economic development of a country (Wadho, Goedhuys & Chaudhry, 2019; Vaz, 2021). The importance of firm growth can be judged from the fact that a number of policies are designed and implemented by the governments all over the world with an aim to promote firm growth (Fadic, 2020). Developing countries are facing a problem

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of unemployment (Murage, 2021). That is why, the firm growth is important for the developing countries. Theoretically, firm growth is affected by firm, industrial, market and macroeconomic volatilities.

The empirical research on volatility and growth of the firm is limited. Despite the importance of the topic, the volatility-firm growth research can be counted on fingers. Keeping in mind the importance of the volatility-firm growth topic, academicians are trying to explore the effects of volatility on firm growth. Thus, in this connection, the policy makers and firm managers are required to understand the volatility firm growth phenomenon. In order, to enhance welfare of the masses. The policy makers in developing countries have been keenly focusing on such policies which can help sustainability in economic growth (Heo, Hou & Park, 2021).

1.1. Background

Firm, industrial, market and macroeconomic volatilities come into picture because it is impossible to avoid it. The connection between growth and volatility is theoretically ambiguous (see, for instance, Imbs, 2007) while empirical studies have also provided mixed results for example, Black (2009) has found a positive relationship. Similarly, Aghion, Angeletos, Banerjee and Manova (2010) have found an inverse association while, Blackburn and Pelloni (2004) have reported mixed relationships. However, it is argued that growing firms not only survive, but also their growth opens the avenues for new and better employment opportunities (Horbach & Rammer, 2020). Particularly, the growth of firms becomes more important in case of populous countries like Pakistan, where unemployment is a major problem. Storey (1994) stated that young firms expected to fail unless they grow early on to reach some minimum efficient level. Contrary to this Choi and Lee (2020) have found that young firms usually grow faster, which results in job creation hence, reduction in unemployment. Furthermore, growth of firms also stimulates economic growth of a country (Dary, Issahaku & Abu 2022). Therefore, volatility affects not only economic and financial decision making but also growth of the firm. The impact of volatility on growth of the firm is a critical issue that needs to be explored.

Growing firms need funds for research and development (R&D) which may result in technological progress (Zeng, Shu & Ye 2022). Further, technological progress boosts product innovation, which leads to growth of the firm (Iza, 2020). Last but not the least; firm growth erodes monopolistic powers in the economy. It is also vital to note that for the survival of firms, it is mandatory that their size overtime is not shrinking because only growing and innovative firms can survive in the long run. On the basis of these important reasons, several researchers have focused firm growth.

1.2. Concept of volatility

Knight (1921) has explained volatility as "uncertainty as peoples' inability to forecast the likelihood of events happening". The circular flow of income takes place among individuals and firms so the growth of firms is beneficial for the whole society (Mishra & Deb, 2018) as it will result in an increase in income of individuals. Empirical evidence on how does volatility affect firm growth is worthwhile from several aspects. In addition, volatilities remain higher in the developing countries as compared to the developed countries (Loayza, Ranciere, Serven & Ventura, 2007). Furthermore, it penetrates not only in life of an individual (Sassi & Mamo, 2019) but also affects firm (Subhani, Ashfaq, Khan, Meyer & Farooq, 2022). In developing nations higher savings may be transferred abroad because of uncertain investment environment at domestic level. On the basis of it, we can say that market and macroeconomic volatilities may also affect growth of the economy in the long run. Similarly, the implications of volatility on growth are adverse in the short run because volatility results in temporary pause of investment expenditures and hiring (Ćorić & Šimić, 2021).

1.3. Differential effect of volatilities on firm sales growth

Apart from direct effect of volatility on firm sales growth, there is possibility that firm, industrial, market and macroeconomic volatilities may affect the growth of firm conditional upon firm-specific characteristics. Further, there is also a possibility that different types of volatilities affect financially unconstrained and constrained firms differently. Many studies have examined the role of credit constraints in firms' investment and financing decisions. The prevailing studies have documented that the firms utilize their available funds and do not borrow because of high costs of borrowing. This literature not only expanded over the recent past but also has received more attention recently. Costly external borrowing increases the cost of capital of the firm and limits the firms' access to the capital market. In addition, those firms who have the ability to obtain external funds at low cost are generally free from the financial constraints. The financing terms as well as conditions has been extensively explored in the prevailing literature. Myers and Majluf's (1984) theoretical model predicted that when firms have a shortage of internally generated funds they do not aggressively invest. Sherazi, Iqbal, Asif, Rehman and Shah (2013) have reported that the financial constraint is the biggest hurdle for doing business in Pakistan. Ramírez (2019) has documented that the firm facing credit constraints in short-run, limit their investment in new projects. Similarly, Navaretti, Castellani and Pieri (2014) have found that firms which have better access to credit are much more productive and tend to grow faster.

1.4. Gap in the literature

In the existing literature the researchers have explored the association between volatility and firm growth particularly for developed countries. For example, Chong and Gradstein (2009) by using survey data of 5000 firms have analyzed only the impact of macroeconomic volatility on firm growth. A large number of researchers have analyzed firm growth, for example impact of exports on firm growth (Barasa, Kinyanjui, Knoben, Vermeulen & Kimuyu, 2021) impact of innovation on firm growth (Mansfield, 1988; Audretsch, Segarra & Teruel, 2014), impact of financial constraints on firm growth (Quader, 2017) and impact of volatility on firm growth (Chong & Gradstein, 2009). Further, in the context of developing economies the impact of volatilities on firm growth is limited. Furthermore, the impact of volatilities on growth of the firm under financial constraints in Pakistan has never been examined. Thus, this study is based on the impact of financial constraints on firms' sale growth in Pakistan.

1.5. Objectives of the study

The core objective of the study is to examine the impact of firm, market, industrial and macroeconomic volatilities on growth of the firm. The existing literature used different methods to measure micro (firm-specific) and macro (country-specific) volatilities. As an initial step we measure volatility at macro level (market and macroeconomic volatilities) and micro level (firm and industrial volatilities).

Objective 1:

To measure the volatility at the firm level (based on sales, cash flow and stock price), capital market level (based on KSE 100 Index), industry level (based on industry sales), and macroeconomic level[4].

Financially constraint firms are those firms which face difficulty in acquiring funds in contrast to financially unconstrained firms which can acquire funds easily. Thus, there may be some differences among the financially unconstrained and constrained firms. Therefore, we are expecting that the volatility may affect differently to the financially constrained firms than their counterparts. Further, financially constrained firms are restricted to a smaller scale of operations because; financially constraints firms cannot exploit prevailing growth opportunities in an economy (Bagh, Arif, Liaqat & Razzaq 2017).

Objective 2:

To examine whether the impact of volatility on growth differs for financially

4 Macroeconomic volatility is based on CPI (consumer price index), ER (real effective exchange rate), IR (interest rate) and IPI (industrial production index)

unconstrained and financially constrained firms.

1.6. Research questions

The study of volatility and firm sales growth has an importance in our daily life, because, the circular flow of income takes place among individuals and firms, so the growth of firms is beneficial for the whole society as it will result in an increase in income of individuals. To attain the objectives of our study, we sketch the following research question.

- Does the impact of volatility differ for financially unconstrained and financially constrained firms?

2. Literature Survey

The voluminous literature is available on firm sales growth in connection with developed countries. However, the research on firm sales growth for the developing economies is limited. Moreover, the studies specifically on Pakistan can be counted on fingers. In this section, we present review of theoretical and empirical literature of the firm growth and volatility. We categorized the literature in three broad categories in terms of their findings. The comprehensive review of all the three categories is covered below.

2.1. Literature on volatility and firm growth in Pakistan

At international level few volatility firm growth studies are available but most of the literature ignored the association between volatility and firm growth. Like Rashid and Hersi (2021) have examined the differential effects of liquidity constraints on firm growth in Pakistan. In order to fill the gap our study is an attempt to empirically investigate such a critical issue so it would be an addition to the existing literature with a positive intention.

2.2. Literature on volatility and firm growth

2.2.1. Introduction

Volatility can never be avoided as it is part of life (Henderson, 2018). Under uncertain environment, firms have to invest so that they might earn something (Naheed, Sarwar & Naheed, 2021). Low or negative growth is bad for economic security (Tsenkov, 2020). Therefore, when firms are experiencing lower or even negative growth, then the importance of volatility becomes many folds. Numerous researchers investigated the association between volatility and growth of the firm, However, they

provide mixed results (Charles & Darne, 2021).

2.2.2. Volatility and firm growth

In a volatile environment, firms are exposed to a number of risks (Baharul-Ulum, Ahmad, Salamudin & Daud, 2015) but the firms have to adopt a specific strategy for investment (Onn & Butt, 2015) so that, in return they may earn potential profit. Surplus is ultimately invested again, which may promote growth of the firm (Yu, Dosi, Grazzi & Lei, 2014). Impact of volatility on firm growth is a complex area. Academicians are trying hard to dig every corner so that to disclose possible explanation of the volatility firm growth relationship from every angle. Based on time series, cross country and panel data studies the impact of volatility on growth of the firm is; positive, negative and zero (Posch & Walde, 2011).

2.3. Classification of volatility and firm growth studies

Literature review has revealed that the opinions in support of positive, negative, and mix association between growth and volatility are equally appealing. The positive theoretical correlation between volatility and growth is the first category of the literature. Under recession the decline in the revenues of the firm are responsible for the positive correlation between firm growth and volatility (Kalyani, 2020; Wijaya, 2021). Especially the declining revenues of unproductive firms will cause business shutdown so the losses may be avoided. This is what the idea of creative destruction is, this idea is introduced by Schumpeter (1939) later on many other researchers have also supported his view (Durnev, Li, Morck & Yeung, 2004; Chun, Kim, Morck & Yeung, 2008; Kim, Baek Lee, 2018). Once less productive firms are destroyed, the market share of productive firms will increase. Therefore the profitability of the productive firms rises. It means that in in the presence of volatility in the long run, there will be growth of firms (see, for instance, Mirman, 1971).

An inverse link between volatility and growth is the second category of the literature. Martin and Rogers (1997) have documented an adverse link between volatility and growth. Therefore, adoption of the fiscal policy to stabilize economy has positive impact on country's economic growth, accumulation of the man power, and welfare of the masses. In order to enhance growth investment is required and investment is effected by volatility. Negative association between investment and volatility is found in a sample of 40 developing countries (Aizenman & Marion, 1999). Fatás (2002) has reported an inverse relationship between volatility and growth. Norrbin and Yigit (2005) have found robust negative association between volatility and output growth. Volatility based on business cycle is detrimental to growth. Therefore, lessor business cycle volatility stimulates growth (Furceri, 2009).

Similarly the third strand of literature supports a mixed relationship between growth and volatility. For example, Blackburn and Pelloni (2004) have reported the mix relationship between volatility and output growth. Further, volatility growth relationship is based on the source of stochastic fluctuations (real or nominal shocks) in a country. Imbs (2007) has documented negative (positive) impact of volatility on growth across countries (sectors). Jetter, Nikolsko-Rzhevskyy and Smith (2013) have documented significant positive direct impact of volatility of wages on growth and a significant negative indirect impact of volatility of wages on growth. Bakas, Chortareas and Magkonis (2019) have reported mix results of volatility growth relationship. Ulke, Varlik and Berument (2019) have documented a positive effect of volatility on growth for mining and quarrying, a negative impact of volatility on growth of manufacturing firms and an insignificant impact of volatility for electricity and gas sector.

2.4. Classification of firm growth studies

2.4.1. Impact of financial constraints on firm growth

Availability of financing is important for the growth of the firms (Hu & Yin, 2022). Inadequate financing facility is a barrier to firm growth (Malhotra *et al.*, 2007). Especially, in case of a developing economy like Pakistan it is the main obstacle to firm growth because in presence of financial restrictions it is difficult for the firms to expand their operations by utilizing profitable investment opportunities. Ahmed and Hamid (2011) have documented, "finance is a binding constraint to firm growth in Pakistan". Therefore, unconstrained firms tend to grow faster than constrained firms (Brzozowski, 2019). Beck, Demirgüç-Kunt and Maksimovic (2005) have reported that the small firms grasp most of the benefits of financial development and reduction in corruption.

Oliveira and Fortunato (2006) have documented that younger as well as smaller firms face more severe effects of financial constraints than the bigger and mature firms. The role of complementarity between access to internal and access to external finance is explored by few researchers. For example, Rahaman (2011) has analyzed the impact of access to internal as well as external financing on firm growth and concluded that access to internal finance has significant positive impact on firm growth. Moreover, the impact of access to internal financing on firm growth diminishes with a rise in access to external finance. Furthermore, after the elimination of barriers on external finance firms switch to external financing facility as a source of firm growth rather than the internal financing facility. The said phenomenon holds generally for all firms and particularly for small firms.

Numerous other researchers also reported that the lack of financial constraints

have a positive impact on firm growth. Access to finance is one of the main sources of growth in the hotel industry. Fowowe (2017) has documented that unconstrained firm experience more growth than the constrained firms. Nichter and Goldmark (2009) have concluded availability of finance is a necessary condition but not a sufficient condition for firm growth. Quader (2017) has analyzed unbalanced panel data of 1122 UK firms and documented that access to finance is vital for the firm growth. Various researchers have documented that with an access to external finance firms switch to external finance from internal finance as a source financing. Guillamón, Moral-Benito and Puente (2017) have reported that financing constraints hinder growth of Spanish firms.

Moscalu, Girardone & Calabrese (2020) have reported that financing constrains are bad for small and medium size firms' growth. Avarmaa (2011) has found financing constraints have a negative impact on firm sales growth of the local firms while foreign firms do not face any financing constraints. Ergun and Doruk (2020) have documented that obstacles to finance are the main hurdles to growth of the non-family manufacturing firms but the said effect was missing for family firms run by well-known big family groups. Dinh, Mavridis and Nguyen (2012) with a sample of more than 39,000 firms from 98 economies have documented that finance is the biggest hurdle faced by the firm. Léon (2020) reported that access to long-term finance has no effect on firm growth but access to short-term finance has a positive impact on growth of the firm.

Although most of the empirical literature concludes ease of financing favor firm growth but few researchers have reported the adverse influence of financing on growth of the firm. For example, Brzozowski (2019) has documented that access to finance is found to be harmful for firm growth. Regasa, Fielding and Roberts (2020) have found that external finance is not good for firm growth. Boohene (2018) has found that access to finance has a negative impact on firm growth. The impact of financing constraints diminishes with the development of the financial markets. Rather the main factor influencing the growth of the firm, entry and exit is finance (Angelini & Generale, 2008).

The standard literature in the field of finance has advocated that the firm can only be classified as financially constrained if it consists of a minimum of one of the following classifications: (i) more growth potential, (ii) small in size, (iii) unprofitable, (iv) new in business, (v) low credit rating, (vi) higher level of leverage, (vii) hold the least amount of cash, (viii) do not pay dividends, (ix) not familiar with the credit market and (x) less debt capacity (Opler, Pinkowitz, Stulz & Williamson,1999; Almeida, Campello & Weisbach, 2004; Acharya, Almeida & Campello, 2007; Duchin, 2010; Chang, Benson & Faff, 2013).

To analyze how financial constraints firms responds to the micro and macro level volatilities, first we classify firms into financially unconstrained as well as constrained categories. Existing empirical studies have proposed numerous measures. Still, there is no agreement. However, theoretically, financially unconstrained firms are in a superior position to handle volatility than their counterparts. To analyze the expected differential impact of volatility on both the financially unconstrained and constrained firms, we are supposed to analyze the following hypothesis.

Hypothesis 1: Volatility affects more strongly the growth of financially constrained firms than financially unconstrained firms.

3. Econometric Model

3.1. Theoretical background

The theory of firm growth can be divided into seven broad categories: the classical theories, stochastic theories, Penrose's theory, Arrow's theory, Marris and "managerialism" theory, evolutionary firm growth theory and population ecology (Carrizosa, 2006; Coad, 2009). The classical theories are based on static and dynamic approach. There are three stochastic theories, namely; Gibrat Law (1931), Kalechi (1945) and of Champernowne (1973). Penrose's theory is based on economies of growth. Arrow's theory is based on the passive learning approach and the active learning approach. Marris theory is based on managerial approach. Evolutionary firm growth theory is based on the principle of "growth of the fitter" and population ecology is based on the availability of the natural resources. These theoretical foundations provide the basis for testing our hypothesis empirically.

3.2. Selection of the control variables

The existing literature identifies the different determinants of firm growth. Such as size (Liu & Hsu, 2006), age (Calvo, 2006), R&D (Czarnitzki & Delanote, 2013), leverage (Niskanen & Niskanen, 2007), Tobin Q (Mak & Kusnadi, 2005), investment (Li & Hou, 2019), profitability (Niskanen & Niskanen, 2007) and cash (Martínez-Sola, García-Teruel & Martínez-Solano, 2013). In order to analyze the impact of volatility on firm growth we follow Chong and Gradstein (2009).

3.3. Volatility and growth of the firm

Following Rauf and Rashid (2021) we empirically estimate the following model to investigate the direct and indirect impact of firm, market, industrial, macroeconomic volatilities and their interaction terms.

$$
\begin{aligned}
FG_{it} \;\&\; = \; & \alpha_0 + \gamma_0 FG_{it-1} + \; \gamma_1 Size_{it} + \gamma_2 Age_{it} + \gamma_3 R\,\&\,D_{it} + \gamma_4 Leverage_{it} \\
& + \; \gamma_5 TobinQ_{it} + \gamma_6 Investment_{it} + \gamma_7 Profitablity_{it} + \; \gamma_8 Cash_{it} \\
& + \; \gamma_9 \sigma_{it}^{Firm} + \gamma_{10} \sigma_{jt}^{Industry} + \; \gamma_{11} \sigma_{t}^{Market} + \; \gamma_{12} \sigma_{t}^{Macro} \\
& + \; \beta_1 \left(\sigma_{it}^{Firm} \times \sigma_{jt}^{Industry} \right) + \beta_2 \left(\sigma_{it}^{Firm} \times \sigma_{t}^{Market} \right) + \beta_3 \left(\sigma_{it}^{Firm} \times \sigma_{t}^{Macro} \right) \\
& + \beta_4 \left(\sigma_{jt}^{Industry} \times \sigma_{t}^{Market} \right) + \beta_5 \left(\sigma_{jt}^{Industry} \times \sigma_{t}^{Macro} \right) + \; \beta_6 \left(\sigma_{t}^{Market} \times \sigma_{t}^{Macro} \right) \\
& + f_i + Y_t + Dum^{ind} + \mu_{it}
\end{aligned}
\tag{3.1}
$$

3.4. Differential impact of volatility

After exploring the effects of volatility on growth of the firm and the effects of interaction between different types of volatility, we examine the indirect impact of volatility on firm growth through various firms' characteristics. Specifically, we examined whether the impact of volatility on firm growth varies with firms' characteristics such as financially constrained and unconstrained position.

3.4.1. Financial constraints and volatility effects

Many studies have examined the impact of financial constraints in firms' investment as well as financing decisions. The existing studies have documented that most of the firms utilize their available funds and avoid borrowing because of high costs of borrowing. This empirical literature has expanded over the recent past and has gotten even more attention recently. Similarly, there are also studies that have explored the effect of volatility in exchange rate in the presence of "credit constraints". These studies find that the export of the firms facing liquidity constraints are likely to affect more by exchange rate fluctuations. There are also some studies that have reported that firm cash holdings decisions are highly affected by their financial constraints. Firms having less available funds are likely to get trouble with the availability of external financing and often get costly external borrowing. Costly external borrowing certainly increases the firms' cost of capital which limits the firms' "access to the capital market" (Rauf & Rashid, 2021). In addition, firm that has the capability to get external finance at a better rate are generally free from financial constraints.

The outcomes of financing terms as well as conditions have been extensively analyzed in the present empirical literature (Rashid & Ashfaq, 2017). Myers and Majluf's (1984) theoretical model has predicted that when firms have a shortage of internally generated funds they do not aggressively invest. Similarly, Navaretti *et al.* (2014) have found that the firms which have better access to credit are much more productive and tend to grow faster. In the presence of tight credit constraints Aghion *et al.* (2010) have found lower and more volatile growth rates. The impact of volatility in the presence of credit constraints is explored by many other researchers. Under

financial constraints volatility raises cost of financing which results in stagnation. Hence growth declines at both micro and macro level (see, for example, Arellano, Bai & Kehoe, 2010; Christiano, Motto & Rostagno 2014; Ergun & Doruk, 2020).

Keeping in view the empirical literature on the role of credit constraints in firms' financing and investment decisions, in this study, we assume that financial constraints have an important role to play in formulating the effects of different types of volatility on firm growth. Therefore, we estimate the proposed models exclusively for financially unconstrained as well as constrained firms to examine whether the effects of volatility differ for these two types of firms. To proceed with this we classify the firm-year observations in financially unconstrained and constrained categories.

To analyze how financial constraints affect the impact of volatility on firm growth, it is important to classify firms into not only financially unconstrained but also financially constrained firms. Existing empirical literature has advocated several alternative measures. Yet, to date there is no agreement among researchers on any one particular measure. Scholars have used a number of measures of financial constraints. Among these measures of the financial constraint most commonly used measure is the Whited and Wu (2006) index (hereafter, WW). To estimate the level of financial restrictions, we follow Whited and Wu (2006), Frésard (2009) Duchin (2010) and Duchin, Ozbas & Sensoy (2010). The model that has been presented in Equation 3.3 estimated for financially unconstrained and financially constrained firms.

3.5. Variable description

In this study, cash flow stock price and sales volatility is used to measure firm volatility. Macroeconomic volatility is based on interest rate (IR), industrial production index (IPI), consumer price index (CPI) and exchange rate (ER). Industrial volatility is based on total sales of all the industries. Similarly, market volatility is measured by the variations in KSE 100 index. The data on all firm-specific variables is gathered from the "balance sheet analysis of non-financial firms". The data of macro level variables is obtained from International Financial Statistics (IFS) and World Development Indicators (WDI). In order to mitigate the problem of survival bias entry and exit of the firms is allowed during the study period.

Table 1: Variable Description

Name	Abbreviation	Description
Firm Growth	FG	Firm growth is the growth of sales (revenue)
Firm Size	Size	Firm size is based on the firm's total assets

Research and Development expenditures	R&D	R&D is the research as well as development expenditure
Firm Age	Age	Firm age is the number of years a firm is in operation
Tobin Q	Tobin Q	Tobin Q is the ratio of market to book value
Leverage	Leverage	Leverage is to the debt ratio
Profitability	Profitability	Profitability is the return on assets
Investment	Fixed Assets	The change in firms fixed assets used as a proxy for investment
Cash	Cash	Cash is the cash flow to total assets ratio
Dummy for industry	Dum	Dum is the industrial dummy
Firm level volatility	σfirm	σfirmis the firm level volatility
Industrial volatility	σIndustry	σIndustryis the industry level volatility (on the basis of industry sales)
Market volatility	σMarket	σMarketis the market level volatility (based on KSE 100 Index)
Macroeconomic volatility	σMacro	σMacrois the macroeconomic level volatility (based on CPI, ER, IR and IPI)

3.6. Measuring macro-level volatility

Volatility is the overtime variability of a variable. Since the introduction of ARCH[5] and GARCH[6] models, the varying conditional variance became the most popular instruments among the finance researchers. Based on the concept of conditional probability, ARCH models are developed. This means that the probability density of the variable under consideration is conditional on the past information. ARCH was introduced by Engle (1982). Later on, GARCH was first introduced by Bollerslev (1986). In the presence of variations in the standard deviation, we have to use ARCH/GARCH methodology rather than ordinary least square because it is one of the most useful tool which can easily handle the problem of heteroscedasticity.

If volatility appears in the form of clusters then GARCH technique can be used. As this technique is based on the concept that large shocks are usually followed by large shocks and in the same fashion small shocks are also bundled together. Such condition of volatility clustering was first discussed by (Mandelbrot, 1963). Later on, several researchers have used GARCH variance series. For example, Fang, Miller and Lee (2008) have used GARCH type specification on output growth volatility. Rashid,

5 Autoregressive conditional heteroskedasticity.
6 Generalized autoregressive conditional heteroskedasticity.

Rauf and Imran (2022) have used GARCH specification for macroeconomic volatility. In the following subsection we provide details for the measurement procedure of macro level volatilities.

3.6.1. Macroeconomic and market volatilities

To measure volatility of IR, IPI, ER and CPI we utilized the concept of (G)ARCH. Similarly, we derive market volatility by utilizing (G)ARCH model for KSE 100 index.

$$\Delta IPI_t = a + d(L)IPI_t + c(l)e_t + e_t\sigma_t^2 = d + \gamma(L)e_t^2$$

where (a) and (d) are the constant terms, (l) is lag polynomial, (c) and (d) are MA and AR terms. (σ_t^2) is the forecast variance (one period ahead) based on the previous information is the estimated variance, and (e_t) is to capture error. (G)ARCH variance series as a measure of IR, IPI, ER and CPI volatilities are obtained by estimating (G) ARCH (1,1) model.

3.7. Measuring firm-specific volatility

Huizinga (1993) used GARCH specification on material cost and wage. Empirical literature suggests us some other approaches to measure volatility, for example Ghosal and Loungani, (2000) estimated volatility by calculating the standard deviation (SD) of firm's unpredictable profits; while Bo and Lensin (2005) to measure firm level risk used volatility of number of employees and stock prices. Baum, Stephan, and Talavera (2009) estimated risk by the SD of share prices. For time varying firm volatility we used the following model presented by Morgan, Rime and Strahan (2004).

$$S_{it} = f_i + f_t + \omega_{it}$$

where (S_{it}) is sales, (f_i) and (f_t) represents firm fixed-effects and year fixed-effects respectively, captures error, i represents i^{th} firm and t represents time. In the section below we are providing details for the measurement procedure of micro level volatilities. The micro level volatility series is based on the concept that the deviations from the firm mean and the mean of overall mean of all the firm in a given period is the respective volatility of a series. Similarly, industrial sales are used to capture industrial volatility. Furthermore, firm volatility is obtained by using the principle component analysis (PCA). The application of PCA on volatility series of sales, cash flow and stock price suggests that the Eigen values of the first principle component is greater than one. Therefore, we obtained firm level volatility series by multiplying the squares of the loadings on the first component with the respective variables. The sum of all the said products is the firm level volatility.

4. Results and Discussion

4.1. Introduction

In this section, the results of the impact of macroeconomic, industrial, market and firm level volatilities on firm sales growth of non-financial firms listed at the PSX during 1988-2017 is reported. Initially, the summary statistics of the data are presented. Later on, the differential effects of firm, industrial, market and macroeconomic volatilities on firm sales growth by categorizing firms into constrained and unconstrained firms are documented.

4.2. Descriptive statistics

The section consists of the summary statistics of the macroeconomic variables used in the empirical analysis are presented.

Table 2: Summary Statistics of Macroeconomic Variables

Variables	LCPI	IR	ER	LIPI
Maximum	5.074829	15.64000	141.5430	5.157445
Mean	3.938175	11.01317	108.2596	4.307356
Std. Dev.	0.709621	3.218365	11.49910	0.450563
Minimum	2.657870	3.940000	89.47218	3.405039
Observations	360	360	360	360

LCPI is log of consumer price index, IR is interest rate, ER is exchange rate and LIPI is log of industrial production index.

The table shows that the mean value of ER is 108.26 which is larger, as compare to IR, LCPI, and LIPI. On one extreme the maximum value of ER is 141.54, on the other extreme the maximum value of LCPI is 5.07. The least value of standard deviation is of LIPI. However, the most value of standard deviation is of ER. Among all the macroeconomic variables variability of the IR is highest. "In developing countries, the IR has been remained volatile in recent years" (Rauf & Rashid, 2021).

Table 3: Unit Root Test

Variables	ADF- Stats (at level) with Cons.		ADF- Stats (At level) with Cons. and Linear Trend		ADF- Stats (At First Difference) with Cons.	
	t-stat.	Prob.	t-stat.	Prob.	t-stat.	Prob.
LCPI	-0.954	0.770	-2.195	0.491	-2.899	0.046
IR	-2.640	0.086	-2.706	0.235	-3.850	0.003

ER	-2.182	0.213	-1.654	0.769	-8.892	0.000
LIPI	-0.718	0.839	-1.278	0.892	-6.099	0.000

LCPI is log of consumer price index, IR is interest rate, ER is exchange rate and LIPI is log of industrial production index.

At level with a constant and linear trend and with constant the Augmented Dickey-Fuller (ADF) test indicates, the presence of unit root in all the four macroeconomic variable series. The ADF test advocates, the variables are stationary at first difference. In addition, Q-stats and Autoregressive Conditional Heteroskedasticity-Lagrange Multiplier test have confirmed the presence of ARCH effect. Therefore on the basis of the recent literature (see, Rauf & Rashid, 2019), we obtained (G)ARCH variance series based on (G) ARCH models.

Table 4: (G)ARCH Estimates for Macro level Risk

Regressors	**ΔLCPI**	**ΔLIPI**	**ΔER**	**ΔIR**
Constant	0.005***	0.003	-0.042	-0.010
	(0.0004)	(0.004)	(0.114)	(0.055)
AR(1)	-0.541***	0.329	-0.176	-0.138
	(0.130)	(1.389)	(0.143)	(1.505)
MA(1)	0.749***	-0.293	0.522	0.074
	(0.110)	(1.391)	(0.124)	(1.462)
Constant	0.000003*	0.00006	1.161*	0.162***
	(0.00001)	(0.00005)	(0.615)	(0.053)
ARCH(1)	0.072**	0.021**	0.172***	0.114***
	(0.029)	(0.010)	(0.063)	(0.036)
GARCH(1)	0.865***	0.968***	0.431*	0.564***
	(0.053)	(0.014)	(0.240)	(0.118)
Diagnostic Tests				
Log likelihood	1259.252	360.027	-689.971	-262.287
Observations	358	358	358	358
LM-test	0.021	0.008	0.037	0.576
P Value	0.883	0.926	0.847	0.448
Q-stat	0.022	0.009	0.037	0.585
P Value	0.883	0.926	0.848	0.444

Note: *, ** and *** shows significant at the 10%, 5%, and 1% level, respectively.

Further, the results of Q-stats and LM test suggest that there is no ARCH effect left in the series. The descriptive statistics of GARCH variance series is reported in Table 5.

Table 5: Descriptive Statistics of Macroeconomic Volatilities

Variables	GIR	GCPI	GIPI	GER
Mean	0.447537	0.000054	0.008462	2.896863
Maximum	3.141812	0.000162	0.015899	9.078875
Minimum	0.164166	0.000031	0.004481	2.049950
Std. Dev.	0.254607	0.000022	0.003093	1.055314
Observations	358	358	358	358

GIR, GCPI, GIPI and GER are GARCH volatility series of interest rate, consumer price index, industrial production index and exchange rate.

Next, we turn to micro level variables. Table 6 depicts the descriptive statistics of the firm level variables. In Pakistan, mostly firms don't spend on R&D. That is why; arithmetic mean of R&D (0.0041) is comparatively closer to zero. The mean Tobin Q is 0.882 with SD of 6.445. Among the explanatory variables the variable R&D has the lowest mean value of 0.0041 with SD of 0.0292.

Table 6: Summary Statistics of Firm Level Variables

Variable	Obs.	Mean	Std. Dev.	Minimum	Maximum
Firm Sales Growth	8648	38.52	203.29	-0.744	1604.83
Firm Size	9488	11.899	4.183	0.693	20.257
Firm Age	10758	26.577	18.624	0.000	156
R&D Expenditures	6265	0.0041	0.0292	0.000	0.5759
Leverage	9221	0.632	0.409	0.000	13.34
Tobin Q	9488	0.882	6.445	-433.909	183.5
Investment	8801	0.1170	0.5460	0.000	4.0377
Profitability	9345	0.1539	0.165	-3.1117	5.6257
Cash	9449	0.0443	0.0868	-0.0111	1

Table 7 presents the descriptive statistics of micro and macro volatilities. Macroeconomic volatility is the most stable series it has a mean of 0.77198, SD of 0.13818, minimum of 0.5828 and a maximum of 1.2732. However, market volatility series with a mean value of 0.00025, SD of 0.0001 and a range of 0.0002 is the second most stable volatility series.

Table 7: Summary Statistics of Micro and Macro Volatilities

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Firm volatility (σfirm)	4826	0.41297	0.47476	0.00155	12.276
Industry volatility (σIndustry)	9316	0.55278	0.7212	0.00023	18.998
Market volatility (σMarket)	9278	0.00025	0.00017	0.00008	0.0008
Macro volatility (σMacro)	10779	0.77198	0.13818	0.58280	1.2732

4.3. Financial constraints and volatility effects on firm growth

Pakistani firms mostly rely on debt and their total liability to total asset ratio remained high (Rauf & Rashid, 2021). Due to under developed capital markets it is difficult for the Pakistani firms to raise new equity; hence these firms, has no other option other than loans from the banks (Mahmud & Qayyum, 2003). Therefore, financial constraints faced by Pakistani firms may be an important distinguishing factor for firm growth. In order, to find the better insight the impact of volatilities on firm growth for unconstrained and constrained firms are investigated and the results are reported in Table 8.

4.3.1. Direct and indirect effects of volatility

In case of constrained (unconstrained) firms the link between macroeconomic volatility and firm growth is positive (negative). The effect of market volatility on firm sales growth is highly significant positive for both unconstrained and constrained firms. The impact of industrial volatility on firm sales growth is highly significant negative for all firms irrespective of financial constraints. The impact of firm volatility is positive (negative) for constrained (unconstrained) firms. Both the models presented in Table 8 shows that the impact of firm-industry, industry-market and industry-macro volatility is positive. However, firm-market, firm-macro and market-macro volatility terms are negative for both unconstrained and constrained firms.

In col.(1), Table 8 positive coefficient of firm-industry depicts with increase in firm volatility the effect of industry level volatility on firm sales growth of constrained firms diminishes. Further, rise in industrial volatility enhances the positive link between firm volatility and growth of constrained firms. The significant negative coefficients of firm-market and firm-macro show that the increase in firm volatility shrinks a positive impact of both macroeconomic and market volatility on constraint firms' growth. Similarly a rise in market or macro volatility also shrinks the positive

impact of firm volatility on constraint firms' growth. The positive coefficient of industry-market shows that higher industry level volatility improves the magnitude of the effect of market volatility on growth of the firm. Similarly, with a rise in market volatility the adverse impact of industrial volatility on growth of constrained firm diminishes. Positive industry-macro term exhibits, increase in industrial volatility is associated with amplifying impact of macro level volatility on growth of constrained firms. The significant negative market-macro interaction term conclude declining effects of macroeconomic (market) volatility on constrained firms' growth with an increase in market (macroeconomic) volatility respectively.

The interactive terms presented in col.(2) Table 8 display the interactive effects of micro and macro level volatilities for unconstrained firms. The significant positive coefficient of firm-industry volatility interaction term indicates, the rise in industry level volatility condenses the magnitude of the adverse impact of firm level volatility on growth of unconstrained firms. The negative coefficient of firm-market shows the fading impact of market volatility on firm growth as a result of a rise in firm level volatility. Similarly, higher market volatility is associated with flourishing impact of firm volatility on growth of unconstrained firms. The negative firm-macro volatility interaction term depicts that an increase in firm (macroeconomic) volatility multiply the impact of macroeconomic (firm) volatility on constrained firms' sales growth. The significant positive coefficient of industry-market volatility interaction expresses an increase impact of market volatility on unconstrained firms with rise in industrial volatility. The coefficient of industry-macro volatility is also positive. That means, with increase in industrial (macroeconomic) volatility the negative impact of macroeconomic (industrial) volatility on unconstrained firms strengthens. In a similar manner on the basis of significant negative coefficient of market-macro volatility interaction term represents an increase in market (macroeconomic) volatility enhances (reduces) the negative (positive) impact of macro level volatility on unconstrained firms' growth.

4.3.2. Effects of control variables

The impact of size is positive for not only constrained but also unconstrained firms; however, the coefficient of size for unconstrained firms is much bigger. The reason behind it is that the firms facing financial constraints normally get costly external credit to finance its increasing size. Costly external finance increases the cost of capital of the firm hence; its impact on growth is low. However, unconstrained firms are free from such shortcoming. The coefficient of age for constrained firms is negative while the effect of age on firm growth of unconstrained firms is positive. It means, the constrained firms are not in a position to exploit the market demand by utilizing their experience because these firms may not have sufficient amount of internally generated funds to finance their operations at a larger scale. Similarly, the

positive coefficient of age for unconstrained firms indicates that the firms free from financial constraints exploit potential demand by utilizing their experience because they have enough internally generated funds to finance their operations at a larger scale. The relationship between leverage and firms sales growth is positive for both unconstrained and constrained firms. Therefore, it can be concluded that, the debt financing is equally good for all the firms' sale growth.

The coefficients of Tobin Q are also positive. Therefore, for both constrained and unconstrained firms, Tobin Q is significantly positively associated with firm sales growth. As we were expecting the overall impact of investment and profitability must remain highly significant and positive for all the firms irrespective of financial constraints. Table 8 documents same positive association between investment and profitability. That is both investment and profitability of the firm are equal for all the firms irrespective of the financial constraints. The relationship between excessive cash held by the firms and firm sales growth is a negative for unconstrained firms and positive for constrained firms. The reason behind this is the fact that constrained firms do not have enough financing options, therefore, cash has a favorable impact on firm growth and vice versa.

Table 8: Two-Step System-GMM Estimates for Differential Effects of Volatility on Firm Growth of Constrained and Unconstrained Firms

	Constrained Firms' Growth	Unconstrained Firms' Growth
Lag of Firm Growth	0.0297***	0.0035***
	(0.0098)	(0.0001)
Size	0.0405***	2.3930***
	(0.0124)	(0.0345)
Age	-0.0053***	0.0019***
	(0.0011)	(0.0005)
R&D	0.0723***	0.0006
	(0.0017)	(0.0048)
Leverage	1.5980***	5.9642***
	(0.0316)	(0.0881)
Tobin Q	0.0670***	0.2929***
	(0.0217)	(0.0241)

Investment	0.0261***	0.0183***
	(0.0028)	(0.0010)
Profitability	5.4137***	0.9042***
	(0.0437)	(0.0368)
Cash	0.0160**	-0.0226**
	(0.0067)	(0.0017)
Macroeconomic volatility	0.2179**	-8.8585***
	(0.1092)	(0.3809)
Market volatility	2.2373***	2.6158***
	(0.1454)	(0.0642)
Industrial volatility	-2.8838***	-2.7392***
	(0.0399)	(0.0589)
Firm volatility	0.8288***	-3.3471***
	(0.1119)	(0.1634)
Firm volatility × Industry volatility	1.0403***	7.0309***
	(0.0404)	(0.0738)
Firm volatility × Market volatility	-2.0101***	-1.0765***
	(0.0979)	(0.0386)
Firm volatility × Macro volatility	-2.6762***	-0.9666***
	(0.1551)	(0.2132)
Industry volatility × Market volatility	1.4784***	9.8428***
	(0.0882)	(0.3493)
Industry volatility × Macro volatility	4.0656***	3.4940***
	(0.0826)	(0.0840)
Market volatility × Macro volatility	-2.8703***	-4.6532***
	(0.2435)	(0.1013)
Constant	-2.9133	-22.8009***
	(4.8190)	(3.7641)
Obs.	2549	636
Firms	324	208
Instruments	233	168
Dummy for Industry	YES	YES

Test for Validity		
AR(1)	-4.54	-1.89
	[0.000]	[0.058]
AR(2)	-1.32	-1.40
	[0.188]	[0.162]
Sargan	1207.85	207.51
	[0.000]	[0.000]
Hansen	191.29	123.39
	[0.360]	[0.398]

Standard errors are in parenthesis. Probability values are in square brackets. * p<0.1, ** p<0.05, *** p<0.01

5. Findings and Policy Implications

5.1. Findings

The first finding of the study is the adverse effects of firm, industrial and macroeconomic volatilities on firm sales growth are relatively more for financially unconstrained firms than financially constrained firms. In absence of volatility financially unconstrained firms observe growth in sales. However, firm, industrial and macroeconomic volatilities hamper investments for financially unconstrained firms. The rise in industrial volatility enhances (diminishes) the positive (negative) impact of firm volatility and growth of constrained (unconstrained) firms. Similarly the increase in firm volatility shrinks (increases) the positive (negative) impact of macroeconomic volatility on constraint (unconstraint) firms' growth. The impact of age is a significant negative for constrained firms. Similarly, the excessive cash holding has a favorable impact on firm growth of constrained firms.

5.2. Policy implications

Based on empirical findings we put forward following recommendations. The policy makers are required to control the volatilities so that it may not negatively affect firm growth. Policy makers are advised to design such policies that can reduce the financing constraints for the firms. In this regard policy measures for the relaxation of the financing constraints for the non-financial firms are required. For example ease and speed of the financing facility must be enhanced. In addition, discounted interest rate may be charged from the non-financial firms.

5.3. Limitations and direction for future research

The study is the first attempt to explore the effects of firm, industrial, market and macroeconomic volatilities on firm sales growth in Pakistan. The study is based on a sample of non-financial firms listed at PSX. The limitations of any study provide a number of dimensions for future research. For example, the possible impacts of volatilities and control variable may be different for financial firms. Therefore, there is a need to conduct a separate study of financial firms listed at PSX. This study will contribute towards the existing knowledge of volatility-firm growth relationship. Therefore, such an extension is expected to contribute towards the enhancement of the understanding of all the stakeholders. The study is based on firm sales growth. In future researchers may use other measures of firm growth for example firm growth based on firm size, net income and employment. The study analyzed the possible differences of the impact of volatilities on firm growth for constrained and un-constrained firms, exporting and non-exporting firms and innovating and non-innovating firms. Future research may be conducted on the basis of three different categories; low, medium and high growth firms.

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